READABILITY COMPARISON OF A COMMERCIAL MATHEMATICS
TEXTBOOK AND EXPERIMENTAL MATHEMATICS TEXTBOOKS

by

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A MASTER'S REPORT

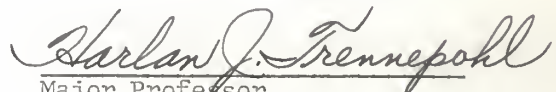submitted in partial fulfillment of the

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TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION

The revolution in the teaching of elementary school mathematics has created a great deal of controversy.[1] Most of the controversy has centered around the use of new procedures. While the tempo of the debate over procedures gains momentum, one very important consideration, the readability of the mathematics material, seems to be overlooked.

Most often committees composed of teachers and/or administrators select the textbooks for their district. They examine many facets of the texts but seldom study the readability of the material, perhaps assuming if a book is written for a specific grade, the children will be able to read the material. Many methods-book authors such as Spitzer recommend techniques for selection of a text but ignore the problem of readability.[2]

How important is the readability aspect of a mathematics program? Cronbach has suggested that about 96 per cent of all curricula are based upon texts.[3] In many classes the textbook is the course of study. It seems apparent that the readability level of the textbook used in the classroom would have a definite

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[1]James W. Heddens and Kenneth J. Smith, "The Readability of Experimental Mathematics Materials," The Arithmetic Teacher, XI, (October, 1964), pp. 391-394.

[2]Herbert F. Spitzer, The Teaching of Arithmetic, (Boston: Houghton Mifflin Company, 1954), pp. 318-329.

[3]Lee J. Cronbach (ed.), Text Materials in Modern Education, (Champaign, Illinois: University of Illinois Press, 1955), p. 207.

influence on the failure or success of the program. Thorpe and other mathematicians have indicated that most of the difficulties in problem solving are reading difficulties.[1] The merits of the mathematics program may be of little value to the student if he is unable to read the text.

STATEMENT OF THE PROBLEM

The purposes of this study were: (1) to compare the readability of a commercial elementary mathematics textbook, Elementary School Mathematics, grade five, with experimental mathematics textbooks, grade five; (2) to demonstrate the application of the Dale-Chall readability formula to elementary mathematics textbooks;[2] and (3) to bring to the attention of elementary teachers, textbook committees, and administrators the existing readability problems among many mathematics programs.

DEFINITION OF TERMS

Commercial elementary mathematics textbook. For this study the commercial elementary mathematics textbook is considered to be a textbook prepared for classroom use by

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[1] Cleata B. Thorpe, Teaching Elementary Arithmetic, (New York: Harper and Brothers, 1962), pp. 315-316.

[2] Edgar Dale and Jeanne L. Chall, "A Formula for Predicting Readability," Educational Research Bulletin, XXVI, (January 21, 1949), pp. 11-20, 28.

professional authors who are employees of the publishing company.
In some instances college professors also serve as writers or
editors for the commercial companies, for example, Harcourt
Brace and World, Incorporated; Ginn and Company; Laidlaw Brothers;
and Scott, Foresman and Company.

Experimental elementary mathematics textbook. For this
study an experimental elementary mathematics textbook is a
textbook prepared by a professional mathematics association or
study group often comprised of classroom teachers, college
professors, mathematicians, and psychologists. In most cases
the leaders are college or university mathematicians and their
primary purpose is to improve mathematics education. Most of
the projects are supported by foundations and/or the federal
government,[1] for example, the School Mathematics Study Group, the
University of Illinois Arithmetic Project, the Madison Project,
the University of Maryland Mathematics Project, the Greater
Cleveland Mathematics Project, the Geometry at Standford
University, the Suppes Arithmetic Project, and the Minnesota
School Mathematics Center.

Reading. Harris defines reading as, "the meaningful
interpretation of verbal symbols."[2]

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[1]John L. Marks, C. Richard Purdy, and Lucien B. Kinney,
Teaching Elementary School Mathematics for Understanding,
(New York, St. Louis, San Francisco, Toronto, London, and
Sydney: McGraw-Hill Book Company, 1965), p.7.

[2]Albert J. Harris, How To Increase Reading Ability,
(New York: David McKay Company, Inc., 1961), p. 8.

Readability. For this study readability refers to the ease in which an elementary mathematics textbook can be read.

LIMITATIONS OF READABILITY FORMULAS

It seems if information obtained by readability formulas is to be of any value to the researcher he must constantly be aware of the limitations of the research tool. Therefore, Jeanne Chall places the following limitations on reading formulas.[1]

(1) Reading formulas should be critically used. Often the grade-placement indexes are accepted as true measures of difficulty.

(2) Readability formulas as prescriptions for writing should be approached with extreme caution. The formulas were not devised as rules for writing. They consider only limited aspects of difficulty.

(3) Validation studies are needed to show the differences in actual reading comprehension as a result of change effected by typical readability campaigns in journalism and industry.

(4) Validation studies on textbooks are needed to throw light on the degree of confidence that can be placed in the grade-level indexes of the various formulas and the extent of agreement among them.

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[1]Jeanne Chall, "This Business of Readability: A Second Look," Educational Research Bulletin, XXXV (April 23, 1956), pp. 89-99.

(5) There is a need for better exchange of results of readability appraisals, especially in education. Since the time and effort involved in appraising a book is still considerable, some provision should be made for exchange of information among publishers, teachers, school systems and libraries.

PROCEDURES FOLLOWED

The Dale-Chall readability formula was applied to a fifth grade commercial mathematics textbook, Elementary School Mathematics, grade five.[1] The results were compared with the findings of Hedden and Smith's readability study of experimental elementary mathematics textbooks, using the Dale-Chall formula.[2]

The Dale-Chall formula bases its prediction of grade level difficulty on the average sentence length and vocabulary load. Rules for selecting samples of a textbook to be analyzed are as follows:

    I. Selecting Samples:
       Take approximately 100 words about every tenth page for books. For articles, select about four 100-word samples per 2,000 words. Space these samples evenly. For passages of about 200 to 300 words, analyze the entire passage. Never begin or end a sample in the middle of a sentence.

    II. Labeling Work Sheet:
       Enter such information as title, author, publisher, date of publication, etc., regarding the sample to be appraised.

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[1]Dale and Chall, loc. cit.

[2]Heddens and Smith, loc. cit.

III. Counting the Number of Words:
    A. Count the total number of words in the sample.
    B. Count hyphenated words and contractions as one word.
    C. Count numbers as words.
       10 is one word.
       1947 is one word.
    D. Count compound names of persons and places as one word.
       St. John, Van Buren, del Rio, Le Brun, and so on are each counted as one word.
    E. Do not count initials which are part of a name as separate words.
       John F. W. St. John is counted as two words-- John and F. W. St. John.
    F. Record the number of words under No. 1 of the work sheet.

IV. Counting the Number of Sentences:
    A. Count the number of complete sentences in the sample.
    B. Record this under No. 2 of the work sheet.

V. Counting the Number of Unfamiliar Words:
   Words which do not appear on the Dale list are considered unfamiliar. Underline all unfamiliar words, even if they appear more than once.

    In making this count, special rules are necessary for common and proper nouns, verbs, and other parts of speech. These are given in the section which follows.

A. Common Nouns:
    1. Consider familiar all regular plurals and possessives of words on the list.
       boy's is familiar because boy is on the list (possessive).
       girls is familiar because girl is on the list (plural by adding s).
       churches is familiar because church is on the list (plural by adding es).
       armies is familiar because army is on the list (plural by changing y to ies).
    2. Count irregular plurals as unfamiliar, even if the singular form appears on the list.
       oxen is unfamiliar, although ox is on the list. Several irregular plurals, however, are listed in the word list. When the plural appears as a separate word or is indicated by the ending in

parentheses next to the word, it is considered
familiar.
<u>goose</u> and <u>geese</u> both appear on the list and are
both considered familiar.
3. Count as unfamiliar a noun that is formed by
adding <u>er</u> or <u>r</u> to a noun or verb appearing on
the word list (unless this <u>er</u> or <u>r</u> form is
indicated on the list).
<u>burner</u> is counted as unfamiliar, although
<u>burn</u> is on the list.
<u>owner</u> is considered familiar because it appears
on the list as follows--<u>own(er)</u>.

B. Proper Nouns:
1. Names of persons and places are considered
familiar. <u>Japan</u>, <u>Smith</u>, and so on, are familiar,
even though they do not appear on the word list.
2. Names of organizations, laws, documents, titles
of books, movies, and so on generally comprise
several words.
a. When determining the number of words in a
sample, count all the words in the name of an
organization, law, and the like.
<u>Chicago Building Association</u> should be
counted three words.
<u>Declaration of Independence</u> should be counted
as three words.

SPECIAL RULE: When the title of an
organization, law, and so on is used
several times within a sample of 100
words, all the words in the title are
counted, no matter how many times they
are repeated.

b. For the unfamiliar word count, consider
unfamiliar only words which do not appear
on the Dale list, except names of persons
or places.
<u>Chicago Building Association</u> is counted
one unfamiliar word--<u>Association</u>.
<u>Building</u> and <u>Chicago</u> are familiar.
<u>Declaration of Independence</u> is counted
as two unfamiliar words--<u>of</u> is on the
list.

SPECIAL RULE: When the name of an
organization, law, document, and so on is
used several times within a sample of 100

words, count it only twice when making the unfamiliar word count.

Security Council, if repeated more than twice within a 100-word sample, is counted as four unfamiliar words.

   3. Abbreviations:
      a. In counting the words in a sample, an abbreviation is counted as one word.

         Y.M.C.A. is counted one word.
         Nov. is counted one word.
         U.S. is considered one word.
         A.M. and P.M. are each counted as one word.

      b. In making the unfamiliar word count, an abbreviation is counted as one unfamiliar word only.

         Y.M.C.A. is considered one unfamiliar word.
         Nov. is considered familiar because the names of the months are on the word list.
         U.S. is considered familiar.
         A.M. and P.M. are each considered familiar.

         SPECIAL RULE: An abbreviation which is used several times with a 100-word sample is counted as two unfamiliar words only.
         C.I.O. repeated five times in a 100-word sample is counted two unfamiliar words.

C. Verbs:
   1. Consider familiar the third-person singular forms (s or ies from y), present-participle forms (ing), past-participle forms (n), and past tense forms (ed or ied from y), when these are added to verbs appearing on the list. The same rule applies when a consonant is doubled before adding ing or ed.

      asks, asking, asked are considered familiar, although only the word ask appears on the word list.
      dropped and dropping are familiar because drop is on the list.

D. Adjectives:
   1. Comparatives and superlatives of adjectives appearing on the list are considered familiar. The same rule applies if the consonant is doubled before adding er or est.

      longer, prettier, and bravest are familiar

because <u>long</u>, <u>pretty</u>, and <u>brave</u> are on the list.

<u>red</u>, <u>redder</u>, <u>reddest</u> are all familiar.

2. Adjectives formed by adding <u>n</u> to a proper noun are familiar. For example, <u>American</u>, <u>Austrian</u>.

3. Count as unfamiliar an adjective that is formed by adding <u>y</u> to a word that appears on the list. But consider the word familiar if <u>y</u> appears in parentheses following the word.

<u>woolly</u> is unfamiliar although <u>wool</u> is on the list.

<u>sandy</u> is familiar because it appears on the list as <u>sand(y)</u>.

E. Adverbs:
1. Consider adverbs familiar which are formed by adding <u>ly</u> to a word on the list. In most cases <u>ly</u> will be indicated following the word.

<u>soundly</u> is familiar because <u>sound</u> is on the. list.

2. Count as unfamiliar words which add more than <u>ly</u>. like <u>easily</u>.

F. Hyphenated Words:
Count hyphenated words as unfamiliar if either word in the compound does not appear on the word list. When both appear on the list, the word is familiar.

G. Miscellaneous Special Cases:
1. Words formed by adding <u>en</u> to a word on the list (unless the <u>en</u> is listed in parentheses or the word itself appears on the list) are considered unfamiliar.

<u>sharpen</u> is considered unfamiliar although <u>sharp</u> is on the list.

<u>golden</u> is considered familiar because it appears on the list <u>gold(en)</u>.

2. Count a word unfamiliar if two or more endings are added to a word on the list.

<u>clippings</u> is considered unfamiliar, although <u>clip</u> is on the list.

3. Words on the list to which -tion, -ation, -ment, and other suffixes not previously mentioned are added are considered unfamiliar, unless the word with the ending is included on the list.

<u>treatment</u> is unfamiliar although <u>treat</u> is on the list.

<u>protection</u> is unfamiliar although <u>protect</u> is on the list.

<u>preparation</u> is unfamiliar although <u>prepare</u> is on the list.

4. Numbers:
   Numerals like <u>1947</u>, <u>18</u>, and so on, are considered familiar.

H. Record the total number of unfamiliar words under No. 3 of the work sheet.

The number of words in the sample (No. 1 on the work sheet) have now been recorded, as well as the number of sentences in the sample (No. 2) and the number of words not on the Dale list (No. 3). The next steps can be followed easily on the work sheet.

VI. Completing the Work Sheet:
   1. The average sentence length (No. 4) is computed by dividing the number of words in the sample by the number of sentences in the sample.
   2. The Dale score or percentage of words outside the Dale list is computed by dividing the number of words not on the Dale list by the number of words in the sample, and multiplying by 100.
   3. Follow through Steps 6 and 7 on the work sheet.
   4. Add Nos. 6, 7, and 8 to get the formula raw score.
   5. If you have more than one sample to analyze, get an average of the formula raw scores by adding all of these and dividing by the number of samples.
   6. Convert the average formula raw score to a corrected grade-level according to the Correction Table given in Table I.

The corrected grade-level indicates the grade at which a book or article can be read with understanding. For example, a book with a corrected grade-level of 7-8 is one which should be within the reading ability of average children in Grades VII and VIII. For adults, the 7-8 grade level can be compared to the last grade reached. If materials are being selected for persons who have had an average of eight grades of schooling, passages with a corrected grade-level of 7-8 should be within their ability. The corrected grade-levels corresponding to the raw scores obtained from the formula are given in Table I. These will serve to determine the grade-level of materials being appraised with the use of the Dale list.

TABLE I

CORRECTION TABLE

Formula Raw Score	Corrected Grade-Levels
4.9 and below	.4th grade and below
5.0 to 5.9	.5-6th grade
6.0 to 6.9	.7-8th grade
7.0 to 7.9	. 9-10th grade
8.0 to 8.9	.11-12th grade
9.0 to 9.9	.13-15th grade (college)
10.0 and above	.16-(college graduate)

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE <u>ELEMENTARY</u> <u>SCHOOL</u> <u>MATHEMATICS</u>-BOOK 5

Page No. __10__

From __Because__

To __Set B__

1. Number of words in the sample . . . . . . ___106___

2. Number of sentences in the sample . . . . ____7____

3. Number of words not on Dale List. . . . . ____10___

4. Average sentence length (divide 1 by 2) . ____15___

5. Dale score (divide 3 by 1, multiply
   by 100) . . . . ____9____

6. Multiply average sentence length (4)
   by .0496. . . . . __.77440__

7. Multiply Dale score (5) by .1579. . . . . __1.4211__

8. Constant. . . . . __3.6365__

9. Formula raw score (add 6, 7, and 8) . . . __5.83__

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE <u>ELEMENTARY</u> <u>SCHOOL</u> <u>MATHEMATICS</u>-BOOK 5

Page No. <u>20</u>

From <u>Chapter</u>

To <u>number</u>

1. Number of words in the sample . . . . . . <u>105</u>

2. Number of sentences in the sample . . . . <u>8</u>

3. Number of words not on Dale List. . . . . <u>4</u>

4. Average sentence length (divide 1 by 2) . <u>13</u>

5. Dale score (divide 3 by 1, multiply
   by 100) . . . . <u>4</u>

6. Multiply average sentence length (4)
   by .0496. . . . . <u>.6448</u>

7. Multiply Dale score (5) by .1579. . . . . <u>.6316</u>

8. Constant. . . . . <u>3.6365</u>

9. Formula raw score (add 6, 7, and 8) . . . <u>4.91</u>

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE ELEMENTARY SCHOOL MATHEMATICS-BOOK 5

Page No. 32

From Repeated

To answer

1. Number of words in the sample . . . . . . _____100_____

2. Number of sentences in the sample . . . . _____10_____

3. Number of words not on Dale List. . . . . _____6_____

4. Average sentence length (divide 1 by 2) . _____10_____

5. Dale score (divide 3 by 1, multiply
   by 100) . . . . _____6_____

6. Multiply average sentence length (4)
   by .0496. . . . . _____.496_____

7. Multiply Dale score (5) by .1579. . . . . _____.9474_____

8. Constant. . . . . _____3.6365_____

9. Formula raw score (add 6, 7, and 8) . . . _____4.63_____

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE <u>ELEMENTARY</u> <u>SCHOOL</u> <u>MATHEMATICS</u>-BOOK 5

Page No. 42

From Number

To   (n x 9)-7

1. Number of words in the sample . . . . . . ____106____

2. Number of sentences in the sample . . . . ____8____

3. Number of words not on Dale List. . . . . ____10____

4. Average sentence length (divide 1 by 2) . ____13____

5. Dale score (divide 3 by 1, multiply
   by 100) . . . . ____9____

6. Multiply average sentence length (4)
   by .0496. . . . . ____.6448____

7. Multiply Dale score (5) by .1579. . . . . ____1.4211____

8. Constant. . . . . ____3.6365____

9. Formula raw score (add 6, 7, and 8) . . . ____5.70____

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE ELEMENTARY SCHOOL MATHEMATICS-BOOK 5

Page No. __52__

From _Chapter_

To___ example 2

1. Number of words in the sample . . . . . . _____105_____

2. Number of sentences in the sample . . . . _____11_____

3. Number of words not on Dale List. . . . . _____15_____

4. Average sentence length (divide 1 by 2) . _____10_____

5. Dale score (divide 3 by 1, multiply
   by 100) . . . . _____14_____

6. Multiply average sentence length (4)
   by .0496. . . . . _____.496_____

7. Multiply Dale score (5) by .1579. . . . . _____2.2106_____

8. Constant. . . . . _____3.6365_____

9. Formula raw score (add 6, 7, and 8) . . . _____6.34_____

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE <u>ELEMENTARY</u> <u>SCHOOL</u> <u>MATHEMATICS</u>-BOOK 5

Page No. <u> 64 </u>

From <u>Reasoning</u>

To<u>   red   </u>

1. Number of words in the sample . . . . . . <u>   196   </u>

2. Number of sentences in the sample . . . . <u>   9   </u>

3. Number of words not on Dale List. . . . . <u>   17   </u>

4. Average sentence length (divide 1 by 2) . <u>   12   </u>

5. Dale score (divide 3 by 1, multiply
    by 100) . . . . <u>   16   </u>

6. Multiply average sentence length (4)
    by .0496. . . . . <u>   .5952   </u>

7. Multiply Dale score (5) by .1579. . . . . <u>   2.5264   </u>

8. Constant. . . . . <u>   3.6365   </u>

9. Formula raw score (add 6, 7, and 8) . . . <u>   6.76   </u>

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE <u>ELEMENTARY</u> <u>SCHOOL</u> <u>MATHEMATICS</u>-BOOK 5

Page No. <u>74</u>

From <u>Chapter</u>

To <u>men</u>

1. Number of words in the sample . . . . . . <u>105</u>

2. Number of sentences in the sample . . . . <u>9</u>

3. Number of words not on Dale List. . . . . <u>11</u>

4. Average sentence length (divide 1 by 2) . <u>12</u>

5. Dale score (divide 3 by 1, multiply
   by 100) . . . . <u>10</u>

6. Multiply average sentence length (4)
   by .0496. . . . . <u>.5952</u>

7. Multiply Dale score (5) by .1579. . . . . <u>1.579</u>

8. Constant. . . . . <u>3.6365</u>

9. Formula raw score (add 6, 7, and 8) . . . <u>5.81</u>

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE ELEMENTARY SCHOOL MATHEMATICS-BOOK 5

Page No. __86__

From Chapter

To __example A__

1. Number of words in the sample . . . . . . ___102___

2. Number of sentences in the sample . . . . ___15___

3. Number of words not on Dale List. . . . . ___19___

4. Average sentence length (divide 1 by 2) . ___7___

5. Dale score (divide 3 by 1, multiply
   by 100) . . . . ___19___

6. Multiply average sentence length (4)
   by .0496. . . . . ___.3472___

7. Multiply Dale score (5) by .1579. . . . . ___3.0001___

8. Constant. . . . . ___3.6365___

9. Formula raw score (add 6, 7, and 8) . . . ___6.98___

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE <u>ELEMENTARY</u> <u>SCHOOL</u> <u>MATHEMATICS</u>-BOOK 5

Page No. <u> 99 </u>

From <u>Transportation</u>

To <u>   trip   </u>

1. Number of words in the sample . . . . . . <u>   106   </u>

2. Number of sentences in the sample . . . . <u>   10   </u>

3. Number of words not on Dale List. . . . . <u>   3   </u>

4. Average sentence length (divide 1 by 2) . <u>   11   </u>

5. Dale score (divide 3 by 1, multiply
   by 100) . . . . <u>   3   </u>

6. Multiply average sentence length (4)
   by .0496. . . . . <u>   .5456   </u>

7. Multiply Dale score (5) by .1579. . . . . <u>   .4737   </u>

8. Constant. . . . . <u>   3.6365   </u>

9. Formula raw score (add 6, 7, and 8) . . . <u>   4.66   </u>

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE ELEMENTARY SCHOOL MATHEMATICS-BOOK 5

Page No. 110

From Averages

To addends

1. Number of words in the sample   103

2. Number of sentences in the sample   12

3. Number of words not on Dale List.   15

4. Average sentence length (divide 1 by 2) .   9

5. Dale score (divide 3 by 1, multiply
   by 100)   15

6. Multiply average sentence length (4)
   by .0496. 4464

7. Multiply Dale score (5) by .1579. . . . .   2.3685

8. Constant. 3.6365

9. Formula raw score (add 6, 7, and 8) . . .   6.45

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE ELEMENTARY SCHOOL MATHEMATICS-BOOK 5

Page No. 120

From Division

To   weeks

1. Number of words in the sample . . . . _____111_____

2. Number of sentences in the sample . . . . . _____9_____

3. Number of words not on Dale List. . . . . . _____17_____

4. Average sentence length (divide 1 by 2) . _____12_____

5. Dale score (divide 3 by 1, multiply
   by 100) . . . . _____15_____

6. Multiply average sentence length (4)
   by .0496. . . . . _____.5952_____

7. Multiply Dale score (5) by .1579. . . . . . _____2.3685_____

8. Constant. . . . . _____3.6365_____

9. Formula raw score (add 6, 7, and 8) . . . _____6.60_____

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE ELEMENTARY SCHOOL MATHEMATICS-BOOK 5

Page No. 130

From Finding

To   divisor

1. Number of words in the sample . . . . . . _____105_____

2. Number of sentences in the sample . . . . _____10_____

3. Number of words not on Dale List. . . . . _____17_____

4. Average sentence length (divide 1 by 2) . _____11_____

5. Dale score (divide 3 by 1, multiply
    by 100) . . . . _____16_____

6. Multiply average sentence length (4)
    by .0496. . . . . _____.5456_____

7. Multiply Dale score (5) by .1579. . . . . _____2.5264_____

8. Constant. . . . . _____3.6365_____

9. Formula raw score (add 6, 7, and 8) . . . _____6.71_____

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE ELEMENTARY SCHOOL MATHEMATICS-BOOK 5

Page No. 141
From The
To acres

1. Number of words in the sample . . . . . . _____112_____

2. Number of sentences in the sample . . . . _____10_____

3. Number of words not on Dale List. . . . . _____0_____

4. Average sentence length (divide 1 by 2) . _____11_____

5. Dale score (divide 3 by 1, multiply
   by 100) . . . . _____0_____

6. Multiply average sentence length (4)
   by .0496. . . . . _____.5456_____

7. Multiply Dale score (5) by .1579. . . . . _____0_____

8. Constant. . . . . _____3.6365_____

9. Formula raw score (add 6, 7, and 8) . . . _____4.18_____

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE ELEMENTARY SCHOOL MATHEMATICS-BOOK 5

Page No. 151

From Long

To exercise 1

1. Number of words in the sample . . . . . . _____122_____

2. Number of sentences in the sample . . . . _____9_____

3. Number of words not on Dale List. . . . . _____12_____

4. Average sentence length (divide 1 by 2) . _____14_____

5. Dale score (divide 3 by 1, multiply
   by 100) . . . . _____10_____

6. Multiply average sentence length (4)
   by .0496. . . . . _____.6944_____

7. Multiply Dale score (5) by .1579. . . . . _____1.579_____

8. Constant. . . . . _____3.6365_____

9. Formula raw score (add 6, 7, and 8) . . . _____5.91_____

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE ELEMENTARY SCHOOL MATHEMATICS-BOOK 5

Page No. 168

From Chapter

To   of 65

1. Number of words in the sample   105

2. Number of sentences in the sample   12

3. Number of words not on Dale List.   21

4. Average sentence length (divide 1 by 2) .   9

5. Dale score (divide 3 by 1, multiply
   by 100)   20

6. Multiply average sentence length (4)
   by .0496. 4464

7. Multiply Dale score (5) by .1579. . . . .   3.1580

8. Constant. 3.6365

9. Formula raw score (add 6, 7, and 8) . . .   7.24

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE <u>ELEMENTARY</u> SCHOOL <u>MATHEMATICS</u>-BOOK 5

Page No. <u>178</u>

From <u>Common</u>

To <u>of 10</u>

1. Number of words in the sample . . . . . . <u>106</u>

2. Number of sentences in the sample . . . . <u>15</u>

3. Number of words not on Dale List. . . . . <u>20</u>

4. Average sentence length (divide 1 by 2) . <u>7</u>

5. Dale score (divide 3 by 1, multiply
    by 100) . . . . <u>19</u>

6. Multiply average sentence length (4)
    by .0496. . . . . <u>.3472</u>

7. Multiply Dale score (5) by .1579. . . . . <u>3.0001</u>

8. Constant. . . . . <u>3.6365</u>

9. Formula raw score (add 6, 7, and 8) . . . <u>6.98</u>

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE <u>ELEMENTARY</u> <u>SCHOOL</u> <u>MATHEMATICS</u>-BOOK 5

Page No. <u>188</u>

From <u>Fraction</u>

To <u>triangles</u>

1. Number of words in the sample . . . . . . <u>   111   </u>

2. Number of sentences in the sample . . . . <u>   11   </u>

3. Number of words not on Dale List. . . . . <u>   11   </u>

4. Average sentence length (divide 1 by 2) . <u>   10   </u>

5. Dale score (divide 3 by 1, multiply
   by 100) . . . . <u>   10   </u>

6. Multiply average sentence length (4)
   by .0496. . . . . <u> .0496 </u>

7. Multiply Dale score (5) by .1579. . . . . <u> 1.579 </u>

8. Constant. . . . . <u> 3.6365 </u>

9. Formula raw score (add 6, 7, and 8) . . . <u> 5.71 </u>

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE <u>ELEMENTARY</u> <u>SCHOOL</u> <u>MATHEMATICS</u>-BOOK 5

Page No. <u> 202 </u>

From <u>A   </u>

To <u>   ring   </u>

1. Number of words in the sample . . . . . . <u>   108   </u>

2. Number of sentences in the sample . . . . <u>   8   </u>

3. Number of words not on Dale List. . . . . <u>   14   </u>

4. Average sentence length (divide 1 by 2) . <u>   14   </u>

5. Dale score (divide 3 by 1, multiply
    by 100) . . . . <u>   13   </u>

6. Multiply average sentence length (4)
    by .0496. . . . . <u>   .6944   </u>

7. Multiply Dale score (5) by .1579. . . . . <u>   2.0527 </u>

8. Constant. . . . . <u>   3.6365 </u>

9. Formula raw score (add 6, 7, and 8) . . . <u>   6.38   </u>

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE ELEMENTARY SCHOOL MATHEMATICS-BOOK 5

Page No. 213

From Fraction

To way

1. Number of words in the sample 101

2. Number of sentences in the sample 20

3. Number of words not on Dale List. 6

4. Average sentence length (divide 1 by 2) . 5

5. Dale score (divide 3 by 1, multiply
   by 100) 6

6. Multiply average sentence length (4)
   by .0496. 2480

7. Multiply Dale score (5) by .1579. 9474

8. Constant. 3.6365

9. Formula raw score (add 6, 7, and 8) . . . 4.85

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE <u>ELEMENTARY</u> <u>SCHOOL</u> <u>MATHEMATICS</u>-BOOK 5

Page No. <u>224</u>

From <u>Equality</u>

To <u>each</u>

1. Number of words in the sample . . . . . . <u>103</u>

2. Number of sentences in the sample . . . . <u>12</u>

3. Number of words not on Dale List. . . . . <u>12</u>

4. Average sentence length (divide 1 by 2) . <u>9</u>

5. Dale score (divide 3 by 1, multiply
   by 100) . . . . <u>12</u>

6. Multiply average sentence length (4)
   by .0496. . . . . <u>.4464</u>

7. Multiply Dale score (5) by .1579. . . . . <u>1.8948</u>

8. Constant. . . . . <u>3.6365</u>

9. Formula raw score (add 6, 7, and 8) . . . <u>5.98</u>

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE <u>ELEMENTARY</u> <u>SCHOOL</u> <u>MATHEMATICS</u>-BOOK 5

Page No. <u>236</u>

From <u>Measurement</u>

To <u>units</u>

1. Number of words in the sample . . . . . . <u>101</u>

2. Number of sentences in the sample . . . . <u>5</u>

3. Number of words not on Dale List. . . . . <u>12</u>

4. Average sentence length (divide 1 by 2) . <u>20</u>

5. Dale score (divide 3 by 1, multiply
   by 100) . . . . <u>12</u>

6. Multiply average sentence length (4)
   by .0496. . . . . <u>.9920</u>

7. Multiply Dale score (5) by .1579. . . . . <u>1.8948</u>

8. Constant. . . . . <u>3.6365</u>

9. Formula raw score (add 6, 7, and 8) . . . <u>6.52</u>

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE ELEMENTARY SCHOOL MATHEMATICS-BOOK 5

Page No. __246__

From __Sums__

To ____ $\frac{11}{24} - \frac{1}{8} = j$

1. Number of words in the sample . . . . . . _____107_____

2. Number of sentences in the sample . . . . _____13_____

3. Number of words not on Dale List. . . . . _____2_____

4. Average sentence length (divide 1 by 2) . _____8_____

5. Dale score (divide 3 by 1, multiply
   by 100) . . . . _____2_____

6. Multiply average sentence length (4)
   by .0496. . . . . _____.3968_____

7. Multiply Dale score (5) by .1579. . . . . _____.3158_____

8. Constant. . . . . _____3.6365_____

9. Formula raw score (add 6, 7, and 8) . . . _____4.35_____

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE ELEMENTARY SCHOOL MATHEMATICS-BOOK 5

Page No. 257

From Short

To Joe's

1. Number of words in the sample   108

2. Number of sentences in the sample   21

3. Number of words not on Dale List.   3

4. Average sentence length (divide 1 by 2) .   5

5. Dale score (divide 3 by 1, multiply
   by 100)   3

6. Multiply average sentence length (4)
   by .0496. 2480

7. Multiply Dale score (5) by .1579. 4737

8. Constant. 3.6365

9. Formula raw score (add 6, 7, and 8) . . .   4.35

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE <u>ELEMENTARY</u> <u>SCHOOL</u> <u>MATHEMATICS</u>-BOOK 5

Page No. <u>267</u>

From <u>Orbital</u>

To <u>Jupiter</u>

1. Number of words in the sample . . . . . . <u>   100   </u>

2. Number of sentences in the sample . . . . <u>   8   </u>

3. Number of words not on Dale List. . . . . <u>   8   </u>

4. Average sentence length (divide 1 by 2) . <u>   13   </u>

5. Dale score (divide 3 by 1, multiply
   by 100) . . . . <u>   8   </u>

6. Multiply average sentence length (4)
   by .0496. . . . . <u>   .6448   </u>

7. Multiply Dale score (5) by .1579. . . . . <u>   1.2632   </u>

8. Constant. . . . . <u>   3.6365   </u>

9. Formula raw score (add 6, 7, and 8) . . . <u>   5.54   </u>

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE <u>ELEMENTARY</u> <u>SCHOOL</u> <u>MATHEMATICS</u>-BOOK 5

Page No.   278

From Decimals

To $6.25 is

1. Number of words in the sample   103

2. Number of sentences in the sample   8

3. Number of words not on Dale List.   6

4. Average sentence length (divide 1 by 2) .   13

5. Dale score (divide 3 by 1, multiply
    by 100)   6

6. Multiply average sentence length (4)
    by .0496. 6448

7. Multiply Dale score (5) by .1579. 9474

8. Constant. 3.6365

9. Formula raw score (add 6, 7, and 8) . . .   5.23

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE ELEMENTARY SCHOOL MATHEMATICS-BOOK 5

Page No. 290

From Basic

To   choose

1. Number of words in the sample . . . . . . ___113___

2. Number of sentences in the sample . . . . ___8___

3. Number of words not on Dale List. . . . . ___21___

4. Average sentence length (divide 1 by 2) . ___14___

5. Dale score (divide 3 by 1, multiply
   by 100) . . . . ___19___

6. Multiply average sentence length (4)
   by .0496. . . . . ___.6944___

7. Multiply Dale score (5) by .1579. . . . . ___3.0001___

8. Constant. . . . . ___3.6365___

9. Formula raw score (add 6, 7, and 8) . . . ___7.33___

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE ELEMENTARY SCHOOL MATHEMATICS-BOOK 5

Page No. 300

From Measurement

To fish is

1. Number of words in the sample . . . . . . _____109_____

2. Number of sentences in the sample . . . . _____9_____

3. Number of words not on Dale List. . . . . _____9_____

4. Average sentence length (divide 1 by 2) . _____12_____

5. Dale score (divide 3 by 1, multiply
   by 100) . . . . _____8_____

6. Multiply average sentence length (4)
   by .0496. . . . . _____.5952_____

7. Multiply Dale score (5) by .1579. . . . . _____1.2632_____

8. Constant. . . . . _____3.6365_____

9. Formula raw score (add 6, 7, and 8) . . . _____5.49_____

A WORK SHEET FILLED IN FOR THE SAMPLES
TAKEN FROM THE ELEMENTARY SCHOOL MATHEMATICS-BOOK 5

Page No. 310

From Chapter

To and 10

1. Number of words in the sample 120

2. Number of sentences in the sample 11

3. Number of words not on Dale List. 9

4. Average sentence length (divide 1 by 2) . 11

5. Dale score (divide 3 by 1, multiply
   by 100) 8

6. Multiply average sentence length (4)
   by .0496. 5456

7. Multiply Dale score (5) by .1579. . . . . 1.2632

8. Constant. 3.6365

9. Formula raw score (add 6, 7, and 8) . . . 5.45

FINAL ANALYSIS WORK SHEET

1. Total number of samples   28

2. Total number of sentences in the samples.   298

3. Total number of words in the samples. 2989

4. Total number of words not on Dale List.   310

5. Average sentence length (divide 1 by 2)   10

6. Dale score (divide 3 by 1 multiply by 100).   10

7. Multiply average sentence length (4) by .0496   496

8. Multiply Dale score (5) by .1579. . . . . 1.579

9. Constant. 3.6365

10. Formula raw score (add 6, 7, and 8) 5.74

11. Average raw score (all samples) 5.81

12. Corrected grade level . . . . 5-6th grade

13. Range . . . . 4th grade to 9-10th grade

The data obtained by applying the Dale-Chall readability formula to the Elementary School Mathematics textbook, grade five, the School Mathematics Study Group textbook, grade five, and the Greater Cleveland Mathematics Project textbook, grade five, are presented in Table II.[1]

The data reveals that the average readability of the Elementary School Mathematics textbook and the School Mathematics Study Group textbook are the same while the Greater Cleveland Mathematics Project's textbook tends to be much higher than the fifth grade level.

The data also reveals that the range of samples from the commercial textbook, grade five, and the experimental textbooks, grade five, indicate a readability level from the fourth grade to grade twelve.

The reading range of samples as given in Table II seems to indicate that many children using the fifth grade material would not be able to read portions of the Elementary School Mathematics, grade five, or portions of the experimental textbooks, grade five.

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[1]Hedden and Smith, op. cit., p. 393.

TABLE II

READABILITY COMPARISON OF ELEMENTARY SCHOOL MATHEMATICS, GRADE FIVE
AND EXPERIMENTAL MATHEMATICS TEXTBOOKS, GRADE FIVE

Title	Publishers	Grade Level	Range of Samples by Grade Level	Average Grade Level
Elementary School Mathematics	Addison-Wesley	5	4-10	5-6
Greater Cleveland Mathematics Project	Education Research Council of Greater Cleveland	5	4-10	7-8
School Mathematics Study Group	Yale University Press	5	4-12	5-6

CONCLUSIONS

Lorge states, "The readability of a text depends upon the kind and number of ideas it expresses, upon the vocabulary and its style, and upon format and typography."[1]

Dale and Hager list seven techniques which are necessary for readable writing.[2] "Define your audience," is one technique, and, "Keep vocabulary as familiar as possible," is another technique for readable writing.

To quote Carleton Washburne:

Children cannot be expected to learn from books which are so written that the mechanical difficulty of reading them occupies the center of the children's attention.[3]

It seems that the authors of the elementary mathematics textbooks under discussion rather than having followed the advice of many authorities have written much of their material far above the level of their audience.

The Elementary School Mathematics, grade five, rather than logically developing its material beginning with easy to read material, randomly distributed the easy to read material and the

[1]Irving Lorge, "Predicting Readability," Teachers College Record, XLV (March, 1944), pp. 404-419.

[2]Edgar Dale and Hilda Hager, "How to Write to be Understood," Educational Research Bulletin, XXVII (November 10, 1948), pp. 207-216.

[3]Carleton Washburne and Mabel Vogel Morphett, "Grade Placement of Children's Books," Elementary School Journal, XXXVIII (January, 1938), pp. 355-364.

more difficult material throughout the textbook. (The readability of the first sample of Elementary School Mathematics was 5-6th grade which would seem rather difficult for many children at the beginning of fifth grade.)

The following conclusions are drawn on the basis of the data:

1. If the elementary mathematics program is to be successful the material must be written on the child's independent reading level, not his frustration level.

2. Teachers, textbook committees, and administrators can not make the assumption that if a mathematics textbook is written for a specific grade, children of that grade will be able to read and understand the material.

3. It seems there is a need for a revision of Elementary School Mathematics, grade five, and the experimental mathematics textbooks, grade five, in order to bring the readability range closer to the grade five audience.

4. It seems that many problem solving difficulties in elementary mathematics can be caused by difficult reading material rather than lack of mathematical ability.

5. Recognizing the limitations of a readability formula, it seems that if careful and conscientious use of the Dale-Chall Readability Formula were carried out it could provide helpful information regarding the relative difficulty of the textbooks which are being considered.

6. Readability studies of elementary mathematics textbooks should be made before making the final selection.

ACKNOWLEDGMENT

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    (January, 1938) pp. 355-364.

Dale List of 3000 Familiar Words[1]

a	alligator	army	balloon
able	allow	arose	banana
aboard	almost	around	band
about	alone	arrange	bandage
above	along	arrive(d)	bang
absent	aloud	arrow	banjo
accept	already	art	bank(er)
accident	also	artist	bar
account	always	as	barber
ache(ing)	am	ash(es)	bare(ly)
acorn	America	aside	barefoot
acre	American	ask	bark
across	among	asleep	barn
act(s)	amount	at	barrel
add	an	ate	base
address	and	attack	baseball
admire	angel	attend	basement
adventure	anger	attention	basket
afar	angry	August	bat
afraid	animal	aunt	batch
after	another	author	bath
afternoon	answer	auto	bathe
afterward(s)	ant	automobile	bathing
again	any	autumn	bathroom
against	anybody	avenue	bathtub
age	anyhow	awake(n)	battle
aged	anyone	away	battleship
ago	anything	awful(ly)	bay
agree	anyway	awhile	be(ing)
ah	anywhere	ax	beach
ahead	apart	bua	bead
aid	apartment	babe	beam
aim	ape	baby(ies)	bean
air	apiece	back	bear
airfield	appear	background	beard
airplane	apple	backward(s)	beast
airport	April	bacon	beat(ing)
airship	apron	ball(ly)	beautiful
airy	are	badge	beautify
alarm	aren't	bag	beauty
alike	arise	bake(r)	became
alive	arithmetic	bakery	because
all	arm	baking	become
alley	armful	ball	becoming

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[1]Edgar Dale, and Jeanne L. Chall, "A Formula for Predicting Readability," _Educational Research Bulletin_, XXVII, (February 17, 1948), pp. 45-54.

bed	biscuit	borrow	bug
bedbug	bit	boss	buggy
bedroom	bite	both	build
bedspread	biting	bother	building
bedtime	bitter	bottle	built
bee	black	bottom	bulb
beech	blackberry	bought	bull
beef	blackbird	bounce	bullet
beefsteak	blackboard	bow	bum
beehive	blackness	bowl	bumblebee
been	blacksmith	bow-wow	bump
beer	blame	box(es)	bun
beet	blank	boxcar	bunch
before	blanket	boxer	bundle
beg	blast	boy	bunny
began	blaze	boyhood	burn
beggar	bleed	bracelet	burst
begged	bless	brain	bury
begin	blessing	brake	bus
beginning	blew	bran	bush
begun	blind(s)	branch	bushel
behave	blindfold	brass	business
behind	block	brave	busy
believe	blood	bread	but
bell	bloom	break	butcher
belong	blossom	breakfast	butt
below	blot	breast	butter
belt	blow	breath	buttercup
bench	blue	breathe	butterfly
bend	blueberry	breeze	buttermilk
beneath	bluebird	brick	butterscotch
bent	bluejay	bride	button
berry(ies)	blush	bridge	buttonhole
beside(s)	board	bright	buy
best	boast	brightness	buzz
bet	boat	bring	by
better	bob	broad	bye
between	bobwhite	broadcast	cab
bib	body(ies)	broke(n)	cabbage
bible	boil(er)	brook	cabin
bicycle	boil	broom	cabinet
bid	bone	brother	cackle
big(ger)	bonnet	brought	cage
bill	boo	brown	cake
billboard	book	brush	calendar
bin	bookcase	bubble	calf
bind	bookkeeper	bucket	call(er)(ing)
bird	boom	buckle	came
birth	boot	bud	camel
birthday	born	buffalo	camp

campfire	cent	circus	column
can	center	citizen	comb
canal	cereal	city	come
canary	certain(ly)	clang	comfort
candle	chain	clap	comic
candlestick	chair	class	coming
candy	chalk	classmate	company
cane	champion	classroom	compare
cannon	chance	claw	conductor
cannot	change	clay	cone
canoe	chap	clean(er)	connect
can't	charge	clear	coo
canyon	charm	clerk	cook(ed)
cap	chart	clever	cook(ing)
cape	chase	click	cooky(ie)(s)
capital	chatter	cliff	cool(er)
captain	cheap	climb	coop
car	cheat	clip	copper
card	check	cloak	copy
cardboard	checkers	clock	cord
care	cheek	close	cork
careful	cheer	closer	corn
careless	cheese	cloth	corner
carelessness	cherry	clothes	correct
carload	chest	clothing	cost
carpenter	chew	cloud(y)	cot
carpet	chick	clover	cottage
carriage	chicken	clown	cotton
carrot	chief	club	couch
carry	child	cluck	cough
cart	childhood	clump	could
carve	children	coach	couldn't
case	chill(y)	coal	count
cash	chimmey	coast	counter
cashier	chin	coat	country
castle	china	cob	county
cat	chip	cobbler	course
catbird	chipmunk	cocoa	court
catch	chocolate	coconut	cousin
catcher	choice	cocoon	cover
caterpillar	choose	cod	cow
catfish	chop	codfish	coward(ly)
catsup	chorus	coffee	cowboy
cattle	chose(n)	coffeepot	cozy
caught	christen	coin	crab
cause	Christmas	cold	crack
cave	church	collar	cracker
ceiling	churn	college	cradle
cell	cigarette	color(ed)	cramps
cellar	circle	colt	cranberry

crank(y)
crash
crawl
crazy
cream(y)
creek
creep
crept
cried
croak
crook(ed)
crop
cross(ing)
cross-eyed
crow
crowd(ed)
crown
cruel
crumb
crumble
crush
crust
cry(ies)
cub
cuff
cup
cupboard
cupful
cure
curl(y)
curtain
curve
cushion
custard
customer
cut
cute
cutting
dab
dad
daddy
daily
dairy
daisy
dam
damage
dame
damp
dance(r)
dancing

dandy
danger(ous)
dare
dark(ness)
darling
darn
dart
dash
date
daughter
dawn
day
daybreak
daytime
dead
deaf
deal
dear
death
December
decide
deck
deed
deep
deer
defeat
defend
defense
delight
den
dentist
depend
deposit
describe
desert
deserve
desire
desk
destroy
devil
dew
diamond
did
didn't
die(d)(s)
difference
different
dig
dim
dime

dine
ding-dong
dinner
dip
direct
direction
dirt(y)
discover
dish
dislike
dismiss
ditch
dive
diver
divide
do
dock
doctor
does
doesn't
dog
doll
dollar
dolly
done
donkey
don't
door
doorbell
doorknob
doorstep
dope
dot
double
dough
dove
down
downstairs
downtown
dozen
drag
drain
drank
draw(er)
drew(ing)
dream
dress
dresser
dressmaker
drew

dried
drift
drill
drink
drip
drive(n)
driver
drop
drove
drown
drowsy
drug
drum
drunk
dry
duck
due
dug
dull
dumb
dump
during
dust(y)
duty
dwarf
dwell
dwelt
dying
each
eager
eagle
ear
early
earn
earth
east(ern)
easy
eat(en)
edge
egg
eh
eight
eighteen
eighth
eighty
either
elbow
elder
eldest
electric

electricity	faint	fill	fond
elephant	fair	film	food
eleven	fairy	finally	fool
elf	faith	find	foolish
elm	fake	fine	foot
else	fall	finger	football
elsewhere	false	finish	footprint
empty	family	fire	for
end(ing)	fan	firearm	forehead
enemy	fancy	firecracker	forest
engine	far	fireplace	forget
engineer	faraway	fireworks	forgive
English	fare	firing	forgot(ten)
enjoy	farmer	first	fork
enough	farm(ing)	fish	form
enter	far-off	fisherman	fort
envelope	farther	fist	forth
equal	fashion	fit(s)	fortune
erase(r)	fast	five	forty
errand	fasten	fix	forward
escape	fat	flag	fought
eve	father	flake	found
even	fault	flame	fountain
evening	favor	flap	four
ever	favorite	flash	fourteen
every	fear	flashlight	fourth
everybody	feast	flat	fox
everyday	feather	flea	frame
everyone	February	flesh	free
everything	fed	flew	freedom
everywhere	feed	flies	freeze
evil	feel	flight	freight
exact	feet	flip	French
except	fell	flip-flop	fresh
exchange	fellow	float	fret
excited	felt	flock	Friday
exciting	fence	flood	fried
excuse	fever	floor	friend(ly)
exit	few	flop	friendship
expect	fib	flour	frighten
explain	fiddle	flow	frog
extra	field	flower(y)	from
eye	fife	flutter	front
eyebrow	fifteen	fly	frost
fable	fifth	foam	frown
face	fifty	fog	froze
facing	fig	foggy	fruit
fact	fight	fold	fry
factory	figure	folks	fudge
fail	file	follow(ing)	fuel

full(y)	God(g)	ground	hasty
fun	godmother	group	hat
funny	gold(en)	grove	hatch
fur	goldfish	grow	hatchet
furniture	golf	guard	hate
further	gone	guess	haul
fuzzy	good(s)	guest	have
gain	good-by(bye)	guide	haven't
gallon	good-looking	gulf	having
gallop	goodness	gum	hawk
game	goody	gun	hay
gang	goose	gunpowder	hayfield
garage	gooseberry	guy	haystack
garbage	got	ha	he
garden	govern	habit	head
gas	government	had	headache
gasoline	gown	hadn't	heal
gate	grab	hail	health(y)
gather	gracious	hair	heap
gave	grade	haircut	hear(ing)
gay	grain	hairpin	heard
gear	grand	half	heart
geese	grandchild	hall	heat(er)
general	grandchildren	halt	heaven
gentle	granddaughter	ham	heavy
gentleman	grandfather	hammer	he'd
gentlemen	grandma	hand	heel
geography	grandmother	handful	height
get	grandpa	handkerchief	held
getting	grandson	handle	hell
giant	grandstand	handwriting	he'll
gift	grape(s)	hang	hello
gingerbread	grapefruit	happen	helmet
girl	grass	happily	help(er)
give(n)	grasshopper	happiness	helpful
giving	grateful	happy	hem
glad(ly)	grave	harbor	hen
glance	gravel	hard	henhouse
glass(es)	graveyard	hardly	her(s)
gleam	gravy	hardship	herd
glide	gray	hardware	here
glory	graze	hare	here's
glove	grease	hark	hero
glow	great	harm	herself
glue	green	harness	he's
go(ing)	greet	harp	hey
goes	grow	harvest	hickory
goal	grind	has	hid
goat	groan	hasn't	hidden
gobble	grocery	haste(n)	hide

high	hotel	insect	junk
highway	hound	inside	just
hill	hour	instant	keen
hillside	house	instead	keep
hilltop	housetop	insult	kept
hilly	housewife	intend	kettle
him	housework	interested	key
himself	how	interesting	kick
hind	however	into	kid
hint	howl	invite	kill(ed)
hip	hug	iron	kind(ly)
hire	huge	is	kindness
his	hum	island	king
hiss	humble	isn't	kingdom
history	hump	it	kiss
hit	hundred	its	kitchen
hitch	hung	it's	kite
hive	hunger	itself	kitten
ho	hungry	I've	kitty
hoe	hunk	ivory	knee
hog	hunt(er)	ivy	kneel
hold(er)	hurrah	jacket	knew
hole	hurried	jacks	knife
holiday	hurry	jail	knit
hollow	hurt	jam	knives
holy	husband	January	knob
home	hush	jar	knock
homely	hut	jaw	knot
homesick	hymn	jay	know
honest	I	jelly	known
honey	ice	jellyfish	lace
honeybee	icy	jerk	lad
honeymoon	I'd	jig	ladder
honk	idea	job	ladies
honor	ideal	jockey	lady
hood	if	join	laid
hoof	ill	joke	lake
hook	I'll	joking	lamb
hoop	I'm	jolly	lame
hop	important	journey	lamp
hope(ful)	impossible	joy(ful)	land
hopeless	improve	joyous	lane
horn	in	judge	language
horse	inch(es)	jug	lantern
horseback	income	juice	lap
horseshoe	indeed	juicy	lard
hose	Indian	July	large
hospital	indoors	jump	lash
host	ink	June	lass
hot	inn	junior	last

late	line	maid	merry
laugh	linen	mail	mess
laundry	lion	mailbox	message
law	lip	mailman	met
lawn	list	major	metal
lawyer	listen	make	mew
lay	lit	making	mice
lazy	little	male	middle
lead	live(s)	mama	midnight
leader	lively	mamma	might(y)
leaf	liver	man	mile
leak	living	manager	milk
lean	lizard	mane	milkman
leap	load	manger	mill
learn(ed)	loaf	many	miller
least	loan	nap	million
leather	loaves	maple	mind
leave(ing)	lock	marble	mine
led	locomotive	march(M)	miner
left	log	mare	mint
leg	lone	mark	minute
lemon	lonely	market	mirror
lemonade	lonesome	marriage	mischief
lend	long	married	miss(M)
length	look	marry	misspell
less	lookout	mask	mistake
lesson	loop	mast	misty
let	loose	master	mitt
let's	lord	mat	mitten
letter	lose(r)	match	mix
letting	loss	matter	moment
lettuce	lost	mattress	Monday
level	lot	may(M)	money
liberty	loud	maybe	monkey
library	love	mayor	month
lice	lovely	maypole	moo
lick	lover	me	moon
lid	low	meadow	moonlight
lie	luck(y)	meal	moose
life	lumber	mean(s)	mop
lift	lump	meant	more
light(ness)	lunch	measure	morning
lightning	lying	meat	morrow
like	ma	medicine	moss
likely	machine	meet(ing)	most(ly)
liking	machinery	melt	mother
lily	mad	member	motor
limb	made	men	mount
lime	magazine	mend	mountain
limp	magic	meow	mouse

mouth	nickel	onward	pan
move	night	open	pancake
movie	nightgown	or	pane
movies	nine	orange	pansy
moving	nineteen	orchard	pants
mow	ninety	order	papa
Mr., Mrs.	no	ore	paper
much	nobody	organ	parade
mud	nod	other	pardon
muddy	noise	otherwise	parent
mug	noisy	ouch	park
mule	none	ought	part(ly)
multiply	noon	our(s)	partner
murder	nor	ourselves	party
music	north(ern)	out	pass
must	nose	outdoors	passenger
my	not	outfit	past
myself	note	outlaw	paste
nail	nothing	outline	pasture
name	notice	outside	pat
nap	November	outward	patch
napkin	now	oven	path
narrow	nowhere	over	patter
nasty	number	overalls	pave
naughty	nurse	overcoat	pavement
navy	nut	overeat	paw
near	oak	overhead	pay
nearby	oar	overhear	payment
nearly	oatmeal	overnight	pea(s)
neat	oats	overturn	peace(ful)
neck	obey	owe	peach(es)
necktie	ocean	owing	peak
need	o'clock	owl	peanut
needle	October	own(er)	pear
needn't	odd	ox	pearl
Negro	of	pa	peck
neighbor	off	pace	peek
neighborhood	offer	pack	peel
neither	office	package	peep
nerve	officer	pad	peg
nest	often	page	pen
net	oh	paid	pencil
never	oil	pail	penny
nevermore	old	pain(ful)	people
new	old-fashioned	paint(er)	pepper
news	on	painting	peppermint
newspaper	once	pair	perfume
next	one	pal	perhaps
nibble	onion	palace	person
nice	only	pale	pet

phone	poke	pumpkin	rattle
piano	pole	punch	raw
pick	police	punish	ray
pickle	policeman	pup	reach
picnic	polish	pupil	read
picture	polite	puppy	reader
pie	pond	pare	reading
piece	ponies	purple	ready
pig	pony	purse	real
pigeon	pool	push	really
piggy	poor	puss	reap
pile	pop	pussy	rear
pill	popcorn	pussycat	reason
pillow	popped	put	rebuild
pin	porch	putting	receive
pine	pork	puzzle	recess
pineapple	possible	quack	record
pink	post	quart	red
pint	postage	quarter	redbird
pipe	postman	queen	redbreast
pistol	pot	queer	refuse
pit	potato(es)	question	reindeer
pitch	pound	quick(ly)	rejoice
pitcher	pour	quiet	remain
pity	powder	quilt	remember
place	power(ful)	quit	remind
plain	praise	quite	remove
plan	pray	rabbit	rent
plate	prayer	race	repair
plant	prepare	rack	repay
plate	present	radio	repeat
platform	pretty	radish	report
platter	price	rag	rest
play(er)	prick	rail	return
playground	prince	railroad	review
playhouse	princess	railway	reward
playmate	print	rain(y)	rib
plaything	prison	rainbow	ribbon
pleasant	prize	raise	rice
please	promise	raisin	rich
pleasure	proper	rake	rid
plenty	protect	ran	riddle
plow	proud	ran	ride(r)
plug	prove	ranch	riding
plum	prune	rang	right
pocket	public	rap	rim
pocketbook	puddle	rapidly	ring
poem	puff	rat	rip
point	pull	rare	ripe
poison	pump	rather	rise

rising
river
road
roadside
roar
roast
rob
robber
robe
robin
rock(y)
rocket
rode
roll
roller
roof
room
rooster
root
rope
rose
rosebud
rot
rotten
rough
round
route
row
rowboat
royal
rub
rubbed
rubber
rubbish
rug
rule(r)
rumble
run
rung
runner
running
rush
rust(y)
rye
sack
sad
saddle
sadness
safe
safety

said
sail
sailboat
sailor
saint
salad
sale
salt
same
sand(y)
sandwich
sang
sank
sap
sash
sat
satin
satisfactory
Saturday
sausage
savage
save
savings
saw
say
scab
scales
scare
scarf
school
schoolboy
schoolhouse
schoolmaster
schoolroom
scorch
score
scrap
scrape
scratch
scream
screen
screw
scrub
sea
seal
seam
search
season
scar
second

secret
see(ing)
seed
seek
seem
seen
seesaw
select
self
selfish
sell
send
sense
sent
sentence
separate
September
servant
serve
service
set
setting
settle
settlement
seven
seventeen
seventh
seventy
several
sew
shade
shadow
shady
shake(r)
shaking
small
shame
shan't
shape
share
sharp
shave
she
she'd
she'll
she's
shear(s)
shed
sheep
sheet

shelf
shell
shepherd
shine
shining
shiny
ship
shirt
shock
shoe
shoemaker
shone
shook
shoot
shop
shopping
shore
short
shot
should
shoulder
shouldn't
shout
shovel
show
shower
shut
shy
sick(ness)
side
sidewalk
sideways
sigh
sight
sign
silence
silent
silk
sill
silly
silver
simple
sin
since
sing
singer
single
sink
sip
sir

sis	snowball	spin	stir
sissy	snowflake	spinach	stitch
sister	snuff	spirit	stock
sit	snug	spit	stocking
sitting	so	splash	stole
six	soak	spoil	stone
sixteen	soap	spoke	stood
sixth	sob	spook	stool
sixty	socks	spoon	stoop
size	sod	sport	stop
skate	soda	spot	stopped
skater	sofa	spread	stopping
ski	soft	spring	store
skin	soil	springtime	stories
skip	sold	sprinkle	stork
skirt	soldier	square	storm(y)
sky	sole	squash	story
slam	some	squeak	stove
slap	somebody	squeeze	straight
slate	somehow	squirrel	strange(r)
slave	someone	stable	strap
sled	something	stack	straw
sleep(y)	sometime(s)	stage	strawberry
sleeve	somewhere	stair	stream
sleigh	son	stall	street
slept	song	stamp	stretch
slice	soon	stand	string
slid	sore	star	strip
slide	sorrow	stare	stripes
sling	sorry	start	strong
slip	sort	starve	stuck
slipped	soul	state	study
slipper	sound	station	stuff
slippery	soup	stay	stump
slit	sour	steak	stung
slow(ly)	south(ern)	steal	subject
sly	space	steam	such
smack	spade	steamboat	suck
small	spank	steamer	sudden
smart	sparrow	steel	suffer
smell	speak(er)	steep	sugar
smile	spear	steeple	suit
smoke	speech	steer	sun
smooth	speed	stem	summer
snail	spell(ing)	step	sun
snake	spend	stepping	Sunday
snap	spent	stick(y)	sunflower
snapping	spider	stiff	sung
sneeze	spike	still(ness)	sunk
snow(y)	spill	sting	sunlight

sunny	taste	tho	too
sunrise	taught	thorn	took
sunset	tax	those	tool
sunshine	tea	though	toot
supper	teach(er)	thought	tooth
suppose	team	thousand	toothbrush
sure(ly)	tear	thread	toothpick
surface	tease	three	top
surprise	teaspoon	threw	tore
swallow	teeth	throat	torn
swam	telephone	throne	toss
swamp	tell	through	touch
swan	temper	throw(n)	tow
swat	ten	thumb	toward(s)
swear	tennis	thunder	towel
sweat	tent	Thursday	tower
sweater	term	thy	town
sweep	terrible	tick	toy
sweet(ness)	test	ticket	trace
sweetheart	than	tickle	track
swell	thank(s)	tie	trade
swept	thankful	tiger	train
swift	Thanks-	tight	tramp
swim	giving	till	trap
swimming	that	time	tray
swing	that's	tin	treasure
switch	the	tinkle	treat
sword	theater	tiny	tree
swore	thee	tip	trick
table	their	tiptoe	tricycle
tablecloth	them	tire	tried
tablespoon	than	tired	trim
tablet	there	'tis	trip
tack	these	title	trolley
tag	they	to	trouble
tail	they'd	road	truck
tailor	they'll	toadstool	true
take(n)	they're	toast	truly
taking	they've	tobacco	trunk
tale	thick	today	trust
talk(er)	thief	toe	truth
tall	thimble	together	try
tame	thin	toilet	tub
tan	thing	told	Tuesday
tank	think	tomato	tug
tap	third	tomorrow	tulip
tape	thirsty	ton	tumble
tar	thirteen	tone	tune
tardy	thirty	tongue	tunnel
task	this	tonight	turkey

turn
turtle
twelve
twenty
twice
twig
twin
two
ugly
umbrella
uncle
under
understand
underwear
undress
unfair
unfinished
unfold
unfriendly
unhappy
unhurt
uniform
United States
unkind
unknown
unless
unpleasant
until
unwilling
up
upon
upper
upset
upside
upstairs
uptown
upward
us
use (d)
useful
valentine
valley
valuable
value
vase
vegetable
velvet
very
vessel
victory

view
village
vine
violet
visit
visitor
voice
vote
wag
wagon
waist
wait
wake (n)
walk
wall
walnut
want
war
warm
warn
was
wash (er)
washtub
wasn't
waste
watch
watchman
water
watermelon
waterproof
wave
wax
way
wayside
we
weak (ness)
weaken
wealth
weapon
wear
weary
weather
weave
web
we'd
wedding
Wednesday
wee
weed
week

weep
weigh
welcome
well
we'll
went
were
we're
west (ern)
wet
we've
whale
what
what's
wheat
wheel
when
when ver
where
which
while
whip
whipped
whirl
whisky
whisper
whistle
white
who
who'd
whole
who'll
whom
who's
whose
why
wicked
wide
wife
wiggle
wild
wildcat
will
willing
willow
win
wind (y)
windmill
window
wine

wing
wink
winner
winter
wipe
wire
wise
wish
wit
witch
with
without
woke
wolf
woman
women
won
wonder
wonderful
won't
wood (en)
woodpecker
woods
wool
woolen
word
wore
work (er)
workman
world
worm
worn
worry
worse
worst
worth
would
wouldn't
wound
wove
wrap
wrapped
wreck
wren
wring
write
writing
written
wrong
wrote

wrung	yes	you'd	you're
yard	yesterday	you'll	yourself
yarn	yet	young	yourselves
year	yolk	youngster	youth
yell	yonder	your(s)	you've
yellow	you		

READABILITY COMPARISON OF A COMMERCIAL MATHEMATICS
TEXTBOOK AND EXPERIMENTAL MATHEMATICS TEXTBOOKS

by

RICHARD JAMES DONALD

B. S., East Stroudsburg State College, 1957

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AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

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The purposes of this study were: (1) to compare the readability of a commercial elementary mathematics textbook, Elementary School Mathematics, grade five, with the results of a readability study of experimental mathematics textbooks by Hedden and Smith; (2) to demonstrate the application of the Dale-Chall readability formula to elementary mathematics textbooks; and (3) to bring to the attention of elementary teachers, textbook committees, and administrators the existing readability problems among many mathematics programs.

The descriptive method of research was used in writing the report. The research revealed that the commercial elementary mathematics textbook and the experimental elementary mathematics textbooks contained material far above the readability level of the specific grade for which it was written.

The Dale-Chall readability formula was applied to samples taken from a commercial elementary mathematics textbook and the results were compared to the readability of experimental mathematics material on the same grade level. While the average readability level of the commercial text, and the experimental textbooks was considered high by the writer, the readability range of the samples was even more striking. Although the samples were taken from fifth grade elementary mathematics textbooks, the readability range was from the fourth grade to the twelfth grade.

Recognizing the limitations of readability formulas and realizing they only provide estimates of readability, the writer

arrived at the following conclusions:

1. If the elementary mathematics program is to be successful the material must be written on the child's independent reading level, not his frustration level.

2. Teachers, textbook committees, and administrators can not make the assumption that if a mathematics textbook is written for a specific grade, children of that grade will be able to read and understand the material.

3. It seems there is a need for a revision of Elementary School Mathematics, grade five, and the experimental mathematics textbooks, grade five, in order to bring the readability range closer to the grade five audience.

4. It seems that many problem solving difficulties in elementary mathematics can be caused by difficult reading material rather than lack of mathematical ability.

5. Readability studies of elementary mathematics textbooks should be made before making the final selection.

6. It seems that if careful and conscientious use of the Dale-Chall readability formula were carried out it could provide helpful information regarding the relative difficulty of the textbooks which are being considered.

7. Measuring the readability of mathematics textbooks seems to place additional limitations on the Dale-Chall formula which indicates a need for a formula better suited to measuring the readability of mathematics textbooks.